ican botanists. The failure to recognize the basic principle of generic types, and the absurd recommendation to make exceptions from the rules adopted in the case of over 400 generic names, make it morally certain that these rules will not be final and will not settle the vexed question of nomenclature. It also seems morally certain that these rules will not be even temporarily accepted by the majority of American systematic botanists. I have read Dr. Britton's paper carefully in the hope that I could find either in or between the lines some hint of the position that he, as chairman of the American Nomenclature Commission, intends to take with reference to these really extraordinary rules. I confess, however, that his purpose has been well veiled. The question is one of such immediate interest and importance in view of the publication of the new 'Flora of North America' that I venture to ask for an expression of his views in your columns as to what shall be done next. For my own part I am free to express the opinion that any attempt to conform to the Vienna rules would be most unfortunate and would only serve to postpone still farther the much-desired attainment of practical stability in the use of plant names.

Fortunately for those of us who are interested in the lower cryptogams, the congress has saved us from the necessity of breaking its rules. If it had confessed its incapacity in regard to the higher plants as well, the situation would be far simpler.

F. S. EARLE.

SANTIAGO DE LAS VEGAS, CUBA,
September 7, 1905.

'CLON' VERSUS 'CLONE.'

I RECUR to this subject merely to correct the misunderstanding under which Professor Eastman labors, as shown in his recent communication to SCIENCE (XXII., p. 206). In my note setting forth the reasons for preferring the spelling *clone,* I did not state the chief fact on which the argument was based, inasmuch as I assumed that any one interested in the subject would undoubtedly consult Mr. Webber's article,[1] in which the word was originally published. Let it be clearly understood, therefore, that viewed in the abstract, one spelling is as good as another, and Professor Eastman's reasons for preferring *clon* would be quite cogent if it were not for the fact that Mr. Webber expressly states that the word is to be *pronounced* with the long sound of *o.* This being the case, I think no one will venture to dispute the point I have already made, that by the requirements of English speech it must be written *clone* or treated purely as a transliteration from the Greek and written *clōn* (preferably *klōn*). Every one of the examples adduced by Professor Eastman (eon, pæon, autochthon, halcyon) affords proof of this, as they are all pronounced with a short *o*! It is quite true, as Professor Eastman states, that 'linguistic usage does not require that loan words and derivatives from other languages should always preserve the same vowel quantities.' But it does require that if the vowel quantity is to be definitely indicated in pronunciation, as Mr. Webber desires in the case of this word, it must be also indicated by the orthography or by some graphic mark of quantity. Hence the word must be treated lexicographically as either *clōn* or *clone.* If written simply *clon,* everyone would be justified in pronouncing it *clŏn.*

CHARLES LOUIS POLLARD.

SPRINGFIELD, MASS.

[1] SCIENCE, XVIII., 501–503, 1903.

SPECIAL ARTICLES.

A DIAGRAM OR CHART FOR FINDING THE SUN'S AZIMUTH.

IN SCIENCE for July 24, 1903, under the title 'On Uses of a Drawing Board and Scales in Trigonometry and Navigation,' I have briefly described such simple apparatus as seemed to be most serviceable in the solution of spherical triangles. What is written here may be regarded as a continuation of that article, because the apparatus there described can be used in place of the azimuth diagram and in ways quite analogous to those here outlined.

Given two sides of a spherical triangle and the included angle, to find one of the remaining angles without first finding the side op-

posite the given angle. Let b, c and A denote the given parts and C the required angle. From the fundamental equations

$$\cos a = \cos b \cos c + \sin b \sin c \cos A, \quad (1)$$
$$\cos c = \cos a \cos b + \sin a \sin b \cos C, \quad (2)$$
$$\sin C \sin a = \sin A \sin c, \quad (3)$$

the quantity a may be eliminated by first dividing (1) by (3), then (2) by (3) with its members interchanged, and then comparing these results. After reducing to a simple form, there results the well-known equation

$$\sin A \cot C = \sin b \cot c - \cos A \cos b. \quad (4)$$

If we write

$$x = \cos A \cos b \sin c - \sin b \cos c, \quad (5)$$
$$y = \sin A \sin c, \quad (6)$$

then

$$\frac{x}{y} = -\cot C, \quad \frac{y}{x} = -\tan C. \quad (7)$$

Since we are here concerned only with the ratio of x and y it is convenient to write

$$x = \cos A \cos b - \sin b \cot c, \quad (8)$$
$$y = \sin A, \quad (9)$$

provided cot c does not become too great, and the ratio x/y or y/x will remain as before.

The azimuth diagram or chart may be described by aid of a sketch, Fig. 1. The radii of the system of concentric semicircles are equal to sin θ where θ varies from 0° to 90°, counting from the center, or to cos θ where θ varies from 0° to 90°, counting towards the center. A system of straight lines radiate from the common center of the semicircular arcs. The angles formed by these lines and the initial line are written in the margin of the diagram. Although not shown in the sketch, the entire diagram is covered by systems of horizontal and vertical lines differing in color or character from the lines already referred to. The entire sheet is thus divided into small squares, the purpose being to enable one to work accurately even if the paper should become somewhat distorted and also to work without marking up the permanent diagram.

If we locate the point x, y upon the azimuth diagram, then by (7) the angle at the center which this point makes with the direction $-x$ is the angle C.

The product sin b cot c of (8) is positive or negative according as c lies between 0° and 90° or 90° and 180°. Its numerical value is the horizontal distance from the central vertical line, measured on a level with the vertex of the circle whose radius is sin b, to the radiating line numbered c.

Upon the radiating line which makes the angle A with the initial direction, mark two points, one where it crosses the outer circle and one where it crosses the circle whose radius is cos b. Follow the horizontal and vertical straight lines until a point is found on a level with the first point and on the vertical passing through the second point.

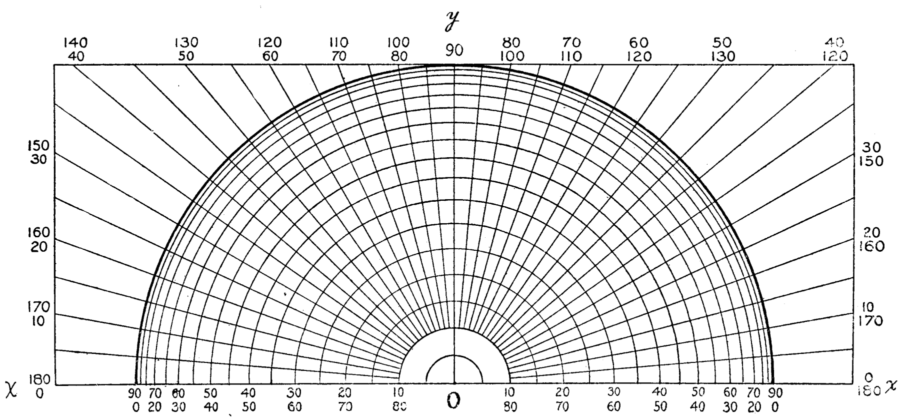

Fig. 1.

Go from this point in a horizontal direction the distance $-\sin b \cot c$. The point thus located is x, y.

When b is greater than 90°, solve the triangle whose given parts are $A, b' = 180° - b$, and $c' = 180° - c$.

Given the latitude of the place and the declination of the sun, to find the true azimuth of the sun at any given apparent time.

Let λ denote the latitude of the place and δ the declination of the sun, north declination being regarded as positive. The product $\cos \lambda \tan \delta$ is positive for north declination and negative for south. Its numerical value is the vertical distance from the horizontal initial line, measured along the vertical line which is distant $\cos \lambda$ from the central line, to the radiating line numbered δ.

Upon the radiating line which makes the (hour) angle A with the initial direction $(+x)$, mark two points, one where it crosses the outer circle, the other where it crosses the circle whose radius is $\sin \lambda$; see Fig. 2. Follow the horizontal and vertical straight lines until a point is found on a level with the first point and on the vertical passing through the second. Go from this point in a horizontal direction the distance $\pm \cos \lambda \tan \delta$, and so locate a fourth point (x, y). The angle at the center between the direction $-x$ and this point is the sun's true azimuth (C) from the north in the northern hemisphere and from the south in the southern. In Fig. 2 as drawn $A = 45° = 3$ hours; $\lambda = 40°$ N.; $\delta = 20°$ N.; $C = 103° 57'$, showing that the azimuth of the sun is then 103° 57′ from the north or 76° 3′ from the south.

A rectangular sheet of waste paper facilitates the determination of the product $\cos \lambda \tan \delta$ and the application of this quantity to locating the point x, y.

If while making a survey λ and δ be regarded as constant, the azimuth of the sun at any given hour and minute can be obtained with great facility.

The uses of the azimuth diagram in great circle sailing and in cartography are too obvious to require comment.

Experience shows that if the radius of the outer circle of the diagram is 16⅝ inches and the circles and the radiating lines go by half degrees, the azimuth under reasonably favorable conditions can easily be found to within about three minutes of its true value.

It is obvious that if two of the three given parts of a triangle are opposites, the unknown part opposite the third given part can readily be ascertained by means of the diagram, because all such products as $\sin C \sin a$, or $\sin A \sin c$, or $\sin A \sin b$ are thereon represented. Such solutions of right-angled triangles as involve only sine or cosine factors can therefore be obtained.

If the x and y of (8) and (9) can not be used on account of the term involving a cotangent, the required angle can still be determined by aid of the diagram, although not as easily as before, because equations (5) and (6) are more complicated than are equations (8) and (9).

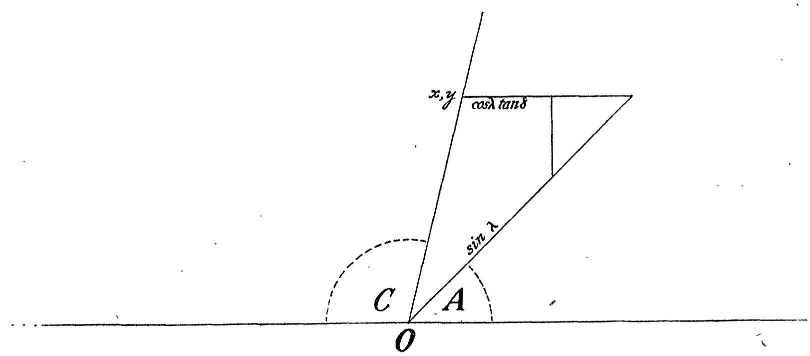

FIG. 2.

The diagram enables one to find such products as those involved in equation (4), and so a graphic solution of this equation as it stands can be carried out if desired.

Since the radiating lines cut the lines $x = \pm 1$ and $y = 1$ in scales of tangents and cotangents, such products as cot b tan c, if the factors are not too great, can be obtained by first finding cot b in the upper margin of the diagram and then going downward (keeping at a distance cot b from the central line) until meeting the radiating line numbered c. The distance thence to the initial or base line is cot b tan c. The cosine scale of the diagram enables one to find the angle whose cosine is equivalent to cot b tan c. This is the angle A of a spherical triangle right-angled at B.

R. A. HARRIS.

ANALYSIS OF THE MISSISSIPPI RIVER.

A SHORT time ago, in conversation with Dr. E. W. Hilgard, of the University of California, I learned, to my great astonishment, that he had been unable to find in any publication a recent and complete analysis of the Mississippi River. Deeming this a serious oversight on the part of chemists at large, a sample was secured for me through the kindness of Mr. J. L. Porter, chemist for the New Orleans City Sewerage and Water Board, and analyzed by me with the greatest of care. The methods employed in the mineral analysis were very similar to those recommended by Professor Bailey, of the Kansas Geological Survey, while the nitrogen determinations were patterned after those made by the Massachusetts State Board of Health.

The sample was taken by J. L. Porter, chemist of the New Orleans City Sewerage and Water Board about noon of May 23, 1905. Location of the sample was opposite Nine Mile point just above Carrollton, in mid-stream, and about six feet below the surface. Temperature of the water at the time was 23° C. Turbidity was about twice the average for the year. Oxygen was about one hundred per cent. of saturation and the free carbonic acid about three parts per hundred thousand.

The results of the analysis are as follows:

Results of Analysis Expressed in Parts per 100,000.

Total solids (unfiltered)	106.9
Total solids (filtered)	16.75
Loss on ignition (unfiltered)	7.4
Loss on ignition (filtered)	2.75
Si	0.35
Al	0.009
Mn	0.012
Ca	2.95
Mg	0.68
Fe	0.008
K	0.23
Na	1.00
SO_4	2.87
PO_4	0.04
CO_3	0.00
HCO_3	11.04
Cl	1.61
Nitrogen as free ammonia	0.016
Nitrogen as albumenoid ammonia	0.014
Nitrogen as nitrites	0.000
Nitrogen as nitrates	0.023
Oxygen consumed (unfiltered)	1.42
Oxygen consumed (filtered)	0.33
Hardness	10.92
Turbidity	Heavy.
Sediment	Large.
Odor (cold)	Practically none.

Results of Analysis Calculated as Oxides.

SiO_2	0.74
Al_2O_3	0.017
Fe_2O_3	0.011
Mn_3O_4	0.016
CaO	4.12
MgO	1.13
K_2O	0.28
Na_2O	1.35
SO_3	2.39
CO_2	7.96

The silica was rather higher than I expected, being about the same as that found in the Hot Springs of Arkansas by Mr. Haywood. Still, it is not a quarter of that occurring in many of our western streams. The ratio of lime to magnesia is about normal, as is the ratio of Na_2O to K_2O, but the amount of bicarbonate seems unusually large, indicating a large percentage of drainage from the arid lands to the northwest. Sulphates form a rather large per cent. of the total solids, but this also is to be expected when we consider